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ABSTRACT

The first (exploratory) phase of the Learning in Science Project focused on science teaching/learning in the Form 1 to 4 level (ages 10 to 14) and sought to identify problems and difficulties in several areas. Provided in this paper are comments obtained during structured/unstructured interviews (from students, ex-students, teachers, headmasters, science advisers, and inspectors) and observations made by project staff related to classroom environment. The intent in presenting these comments/observations is not primarily to provide a balanced view of the good and bad aspects of Form 1 to 4 science, but rather to open up problem issues as project staff and others see them. Comments/observations are presented and discussed as they relate to three major issues: (1) where science is taught, focusing on classrooms and laboratories; (2) to whom science is taught, focusing on how students are grouped in classes; and (3) how the learning environment is organized, focusing on problems of classroom management and individualized instruction. One conclusion stated in the document is that a good learning environment is not dependent solely on the teachers, learners, classroom, or instructional strategy, but is a result of the milieu created by all of these factors. (JN)

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LEARNING IN SCIENCE PROJECT

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FOCUS ON CLASSROOMS

University of Waikato
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The Learning in Science Project is an educational research project undertaken at the University of Waikato under contract to the NZ Department of Education. The project is initially investigating the problems and difficulties of Form 1 - 4 Science (10 - 14 year olds) as a first step to improving teaching and learning.

This paper is one of a set of essays which is an outcome of the exploratory phase of the project. It is our hope that feedback from these essays will assist further to clarify issues and assist us in establishing priorities for the in-depth phase of the project. Any comments our readers have on either the issues involved, or the methodology adopted in these papers, would be most welcome.

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A WORKING PAPER OF THE LEARNING IN SCIENCE PROJECT

Roger Osborne, Peter Freyberg, Ross Tasker

December 1979

This is one of a set of discussion papers which focus on various aspects of Form 1-4 Science. The paper collates comments and observations, related to the topic of focus, which were obtained during the first phase of the Learning in Science Project. In this phase we were particularly concerned about problems and difficulties in Form 1-4 Science and because of this the paper is biassed toward issues as identified by pupils, ex-pupils, teachers, headmasters, science advisers, inspectors as well as by our own observers. Our intention in writing the discussion papers is therefore not primarily to provide a balanced view of the good and bad aspects of Form 1-4 Science but rather to open up problem issues as we and others see them, to a limited but wider audience than the project team.

It is our hope that our chosen readers will be prepared to talk to us about the topic under focus in this paper in terms of the following questions:

- (i) Are the issues we have raised important and central issues which are of general concern?
- (ii) Are there other more basic issues, or other subsidiary questions, about the topic which we have overlooked?
- (iii) Which aspects of the topic could we profitably analyze further in the in-depth phase of the project?
- (iv) What possible solutions to some of the issues raised could profitably be the subject of further study?

INTRODUCTION

The environment in which one works is undoubtedly important. The room, the people one works with, and the way things are organized are all important factors in providing a congenial working atmosphere. Such factors are important when working at science, whether one is learning or teaching.

Let us first consider learning

36/10/1 ¹ "There is a science room but it is not much good because all the equipment is all wrecked and everything...we do nothing really interesting."

[Form 2 pupil]

15/1/2 "Making hokey pokey was a good time why? I guess we were all involved in it."

[ex-pupil]

12/9/2 "[in F1 and 2 science] was very enjoyable then...we had a very good enthusiastic teacher who did science for all the classes and everything. It was very good and very enjoyable."

[ex-pupil]

43/6/3 "There were a few fellows who wanted to do it but I distracted them sometimes...because I had nothing else to do when she was talking so I started talking to one of the other fellows in class...then I would get the blame for distracting all the other fellows in the class and all that."

[ex-pupil]

15/3/2 "At the beginning of the third form...the labs looked pretty impressive."

[ex-pupil]

Teachers are also working.

9/14/3 "If you are a well organized science teacher right on the ball and you have everything at your fingertips and you are a step ahead all the time then it is fantastic and the kids will love the lesson and so will you."

[intermediate teacher]

Some teachers have mentioned the satisfaction of setting up a working environment and then working with the children.

83/3/1 "I feel most useful when I get these guys come up to me with obscure questions that I have to go and look up as well...you know...at least I know what they are talking about and I know where to look it up and find the answer for them."

[Form 1-7 science teacher]

¹ Denotes tape/page/section of original transcript.

" In this team teaching situation we get the opportunity to work with kids - we also get the opportunity to interact while we're teaching...you know...if you're not sure of a fact you can turn around and ask the other teacher...if he's not sure of a fact he can go away and look it up for you and the kids can see that the teachers aren't a know-it-all, we don't pretend to be know-it-all's, you know."

[intermediate teacher - open plan]

This essay discusses three issues :

- (i) where science is taught, with focus on classrooms and labs;
- (ii) to whom science is taught, with focus on how students are grouped in classes; and
- (iii) how the learning environment is organized, with focus on problems of classroom management.

CLASSROOMS AND LABORATORIES

When it comes to the type of room which is used for the teaching of science there is a dramatic difference between Form 1 and 2 and Form 3 and 4 Science.

At intermediate school level most schools were originally set up with a science room. However, the use of such a room exclusively for science has eroded in many schools.

10/1/1

"There is a lack of science classrooms and science specialists in intermediate schools. The Department is forcing intermediates to use science classrooms for normal class teaching and there is no staffing provision for a science specialist."

[intermediate principal]

Perhaps this situation of no science room has arisen simply because schools did not use them.

36/1/2

"When you first got there [intermediate school] it was really exciting because they have this science lab. and you're going to do science in the science lab. and it is really exciting...but you hardly ever used it...form one science was pretty boring really."

[6 form pupil]

or because a number of people consider such a specialist room is not required

14/3/1

"We have got some evidence that where teachers are interested and have the competency they can operate the science experiments very well without a specialist classroom."

[primary inspector]

We believe many teachers and pupils do not share that view.²

9/6/2 "I don't think teachers can be expected to do experiments in their classrooms, I really don't. Not in the normal classroom situation. [At this school] you have to shoot over to the science room and get yourself [for example] four different trays so that you've got a burner and a test tube holder and a tripod and a gauze. And it takes you an hour to set it up because it is not all set up, and you find half way through that you haven't got such and such anyway."

[intermediate teacher]

22/15/3 "[At intermediate] it wasn't a science room, it was just an ordinary room...it didn't have sinks or anything in it so that you couldn't do any experiments like you know with a bunsen or anything like that."

[ex-pupil]

42/2/3 "The classroom is not always suitable...the classroom we are working in has carpet on the floor and so you can't go and do various things on those."

[intermediate teacher]

As implied earlier, students do react positively to a special science room.

16/6/2 "We had a science room...that was good...one teacher took our class for science while our teacher took his class for something."

[ex-pupil]

When it comes to laboratories, Form 1 and 2 pupils in Form 1-7 schools can be at a considerable advantage.

81/8/1 "The big advantage [of F1-7 schools] is that pretty well all [science] classes spend all their time in laboratories."

[Form 1-7 science teacher]

At the secondary school level things are different. Most science lessons take place in science laboratories and many teachers are fortunate enough to teach all their science in one particular laboratory.

18/6/1 "I have my own lab. here and that makes a tremendous difference... that's one of the things that I have found enjoyable so far."

[first year secondary teacher]

20/10/2 However, there are problems with laboratories in secondary schools, "We anticipate next year that we could have 37 class-periods in science out of laboratories and the management problems in that are just

² McMurray (1971) in his Dip.Ed. thesis (Massey) quotes the teacher who stated on a questionnaire about Form 1 Science

"I liken the science expected in the average classroom to a housewife trying to do baking in the laundry."

incredible."

[H.O.D. science - large school]

26/3/1

"It is very difficult for teachers who have to teach in different labs."

[secondary teacher]

26/2/2

"3rd form teaching does not suit the room I am in [lab. designed for science biology]."

[secondary teacher]

It is clear that teachers prefer teaching science in a laboratory, probably as much because equipment is on hand when required as because of the actual services of gas, water and electrical power that it provides. Nevertheless certain things about a laboratory which might be taken for granted are important. We have seen teachers in ordinary classrooms having difficulty simply because students do not have a large flat surface on which to work, the problem of classroom carpet has already been mentioned, and there is often the problem of arranging furniture to allow satisfactory group work.

If laboratories are not going to be built or used for F1 and 2 classes, serious consideration needs to be given to the features which need to be incorporated into ordinary classrooms to enable science to be taught effectively. At the F3 and 4 level, the scattering of laboratories through a school results in serious difficulties if equipment, written resources and teachers must move from one laboratory to another³. Is it sensible to design single purpose advanced laboratories unsuitable for junior science if it is likely that not all junior science can be accommodated in suitable laboratories? Also at secondary school level, if labs. cannot be provided for all, is there a place for multi-purpose rooms which contain certain features of laboratories (a large table, a power point and a sink, for example) but which can also be used for teaching other subjects, such as mathematics?

³ Short (30-35 minute periods) exacerbate this problem. Longer periods mean few upheavals in any one day.

THE CLASS GROUP

The first factor one considers about any class is how many pupils are in it. This is a major factor to be considered when science is to be taught.

9/2/3 "The other thing is...and this would be just a teaching problem... when you have got 34 in your room..."

[intermediate teacher]

35/3/3 "[we need] an insistence by regulation that we put a maximum number in any laboratory...because we have that in the practical field e.g. woodwork ...we say you can't have more than 28 in a workshop and it is equipped for 24...at the moment we equip a laboratory for 30 and very often they try to put more than 30 in a lab. and this makes it too difficult for the teacher."

[secondary science inspector]

The next question is 'what is the ability range of the pupils in the class?' Many teachers have commented to us about the problems of the wide range of abilities in their classes or on the trend toward mixed ability teaching.

25/13/2 "I suppose you are aware that we don't have any streaming, and that is continually hard because there is always some people who can do everything easily and some people who always have trouble with whatever you set them. In a sense you would have to go back so far with the slow kids that it would be pointless. And that is a real tension I find...There is some kid here who is struggling away and still hasn't got the first sentence done and someone else is way ahead. [The differences become] painfully obvious and the slow kids feel a bit sort of bad about that...While their friends are pretty good - someone will help their friend or their neighbour - sometimes you do get it where they really start to feel a failure."

[secondary science teacher]

9/3/2 "The other problem I have is such a varying range of ability... some of them produce fantastic books and then you'll get others who haven't even glued the plants in yet...so you are fighting this problem all the time."

[intermediate teacher]

25/1/1 "Certainly teaching to a mixed ability group makes teaching much more difficult. There is no doubt about that...It does mean that you are pretty well forced to think about people in your class in terms of their individuality, rather than in terms of a group, and I think that is very important."

[secondary teacher]

26/6/1 "A problem is the range of abilities one has in the class [mixed ability class] ...if you provide for the average type of child

you find that the brighter ones are not going to be extended and the lower ones are still not going to be able to cope with it."

[secondary teacher]

The problems of the bright children and the weaker children in wide ability range classes has been mentioned by many others as well.

22/9/2

"I find the middle stream is such a variety...it always has [about] two people who are outstanding and about three people who are well known trouble makers in the school...the rest are the grey majority and it is very difficult because there are a couple of people who are invariably left behind...I feel sorry because they must be frustrated and bored, quite often, and the ones who are sitting in the front sighing heavily because they are bored because you are going too slowly for them...it really is very tricky in that respect.

[secondary teacher]

23/8/2

"You have got the fast ones that are a way ahead and the slow ones are having a really hard time reading the work in the book."

[secondary teacher]

17/20/2

"I have a wide range [of ability] even though they are an [banded] average to low...I've got one or two that I would call good average who are probably bored because I've had to tailor the lesson to the average ability of the class if you like...perhaps I am not offering them enough...I've given them the opportunity to extend themselves with project work but they are not interested in extending themselves even with my encouragement."

[secondary teacher]

26/4/1

"I think we tend to ignore the bright child [in mixed ability classes]...I do...I know I shouldn't...because we feel that they can look after themselves...they will be all right in the end...you're capable of doing it...you just do it...and you tend to possibly concentrate on the slow learner and try to help them...We possibly disadvantage the brighter child more so than any of the others...It is unfortunate...and the same thing seems to be going right through the 3rd form, the 4th form, and the 5th form...in some instances I suppose we can put them off by doing that...unless they are well motivated...but then what can you do?"

[secondary teacher]

What does the bright child think about it?

36/3/3

"I think non-streamed classes are terrible...and that is really where you lose a lot of your potential greats...because they turn off...they get so bored and frustrated and they just can't be bothered and they take the easy way out...the problem is that people say that if you're bright you will learn anyway which I don't think is a fair thing...I mean sure you learn but think of how much more you could be learning if you were really pushed."

[7 form pupil]

With all these disadvantages there must be some reason for the trend to mixed ability teaching!

6/17/3

"[Many] schools have done it very willingly - they see it very much in behavioural terms, they feel that the lower ability kids are going to do better by interacting with the other kids...[the schools] feel that their [the children's] behavioural growth is more important than intellectual growth...that the intellectual disadvantages that the so called better kids will get are not as much as the behavioural disadvantages lower ability kids will get [in streamed classes] but what they are finding is that brighter kids are suffering because the teachers are not making provision for them. I think they can but again the teachers have got to be trained to do this, in terms of being able to provide project material and things like that which will extend those kids...But a bright kid bored is going to be much more constructively devious than a less able kid who is bored...I am not sure about it at all...but the thing is a lot of Science Departments are being pulled into this because it is the English and Social Studies people who can see the advantages."

[secondary science adviser]

Some pupils we have talked to, too, have been in favour of mixed ability teaching.

11/4/1

"I reckon if they had the kids that are brighter...some of the kids really have brains to learn...and those that can't really learn anything in a short time and mixed them [in one class]... then kids who do know what they are talking about can help them ...'cause the teacher can't go around 31 kids in one day and individually teach them...[also] most kids are too scared to say if they don't understand."

[ex-pupil]

Sounds good in theory!

22/9/2

"They say don't they that the ones who are a little bit slow are helped along by the others...[but] they tend to sit apart for one thing...I don't think they get helped along but I do think it is a good thing that the slower ones are not branded as they tended to be put in a class with an appropriate name. It does make it difficult [having mixed ability] but you can manage... teaching to the middle of the class though is letting a quarter of them [at both ends] down."

[secondary teacher]

81/7/2

"Inevitably [with mixed ability groups] there are some kids who miss out and I think they miss out at both ends [of the ability range] quite honestly."

[Fl-7 science teacher]

Of course the problems of the very bright and the very weak don't disappear in streamed classes!

22/9/1

"The hardest of the lot is 4D as you get all your trouble makers in together and 4A is not as easy as you think because they are extremely demanding."

[secondary teacher]

There is no simple solution and many science teachers are presented with a fait accompli as to the size of class and the ability range they have to cope with. Let us therefore turn to the problem of classroom management.

CLASSROOM MANAGEMENT

As implied in the last section the trend toward mixed ability teaching is resulting in problems for teachers particularly in terms of classroom organisation. Many teachers consider that at least in theory the ideal way to teach science to a class of wide ability range is by considerable emphasis on individualised or small group work.

17/5/3

"My ideal situation in the school would be being able to go to my class, my technician has set out all the gear, I perhaps give a wee talk to the class 5-10 minutes on some sort of concepts - a few questions/answers about revision, something like that... then say 'right you know the units on...go to it in your groups' an adviser to small groups...the labs would have to be set up with all the equipment on racks and pegs...you know the individualised approach."

[H.O.D. Science]

8/3/2

"I see the desirability of individualised programs where you are in fact training them to be able to get on...on their own and think about what they are doing."

[secondary teacher]

25/10/2

"My fourth form has been a bit of a pain in the neck and won't settle down...I have just started them on JSSP [an individualised program] partly as a means of revision and partly to settle them down...and they are sorting themselves out now and it's working quite well...and it means I don't have to talk to the class much so that there is no real opportunity to defy me talking...because I don't talk to them...I can spend my time getting around and quietening down things and helping people who can't work and that sort of thing."

[secondary teacher]

24/3/3

"The thing I have tried to do is to provide a basically individualised type program [for a mixed ability class] using small groups as much as possible and using buddy systems and things like that where they actually help each other.[I try to] keep them away from a very formalised system, where I talk at the front of the room, as much as possible."

[secondary teacher]

17/9/2

"We are using the Mice and Men unit [ASEP individualised approach] next door and that to me, a very conservative, very traditional teacher, it's probably been the most exciting program of science teaching that I've ever enjoyed. Because it involved every child or pupil in the room, they worked in small groups...the work set out in the booklet was simply stated and yet very very accurate...they had to make observations from real live mice which they had to record...the experiments that they had to carry out were there in black and white and I was amazed...in fact for the first time in my life I've had kids come to me and say 'Sir, we miss our Science today...we've got to go to an assembly.' And they were really upset."

[secondary teacher]

Are individualised programs the panacea for all problems? Some are reluctant to try them. One teacher discussing the problems of teaching including the problem of a wide ability range, stated,

26/6/2

"I suppose I am one of the old school which is used to teaching the whole class a particular topic...setting them particular experiments to do and seeing that they are done as a class...Possibly switching to group work where they are allowed to work at different speeds and using different materials would be an advantage but this is where I need time and experience to change. I find that the difficulty lies in that you have got to find work for everybody...some of the books are difficult to read. If you provide for the average type of child you find that the brighter ones are not going to be extended and the lower ones are still not going to be able to cope with it, so it's finding suitable material for literally every range."

[secondary teacher]

another states,

17/20/3

"I've had a look at them [individualised material - e.g. ASEP] with a view to using them but I find I can't really use them with the class I have got...I'm not sure how to use them...I'm not equipped to use them really...I haven't been shown how to use an ASEP unit...I've got the book...just looking through them I don't think that the class would react very well to them...they have a fairly anti-attitude [to science]."

[1st year secondary teacher]

Those that do take the plunge and try an individualised program may have problems. One teacher tried a mastery type approach in his first year,

18/2/2

"I did try in various units to get an individualised thing going but the problem was that I was stuck up the front here [of the room] and data was coming in and I was checking it, various skills and things [included tabulated results conclusions, set tasks completed] just a series of skills and you just tick them off...but they were bringing stuff up and you are stuck to the front bench...under the circumstances it is very difficult to set up in science because the kids are doing something out here and you want to keep tabs on what they are doing...move around and help

them individually as the problem occurs rather than kids coming up to you all the time and you stuck there."

[2nd year secondary teacher]

Other views include,

21/5/2

"The only problem in the individualised approach is that you need such a lot of gear and it's a little difficult to give help to everyone that needs it because there may be three or four different activities going on in the room at the same time. But apart from that I think the individual approach [to that topic] has certainly for me worked better than [the way I did it] in the past."

[P.R. Junior Science]

23/9/2

"We have been trying [an individual approach] where you write up a scheme up on the wall [for the pupils]...flow chart...showing them where to go and what to do...loops...certain times they do that...but I found they didn't cope with it very well. They were continually coming up and asking me where they went next. Now two main problems come out...some skipped through it and did it very shallowly and didn't get into it in depth as I wanted them to...and others they got bogged down on one little bit and what should have taken a period took them a week. They really had little concept of how much effort to put into the instructions... like the instructions might say 'read page such and such and write down a definition of each of these five words...and they might spend a period doing just that...not necessarily because they are lazy but just because they think that is their period's work... that is just that one little section, Section 1, then you do that in a period then Section 2 you leave until tomorrow. I guess if I persevere I will teach them how to use such a sequence as that... but at the moment I have found it wasn't really workable."

[secondary teacher]

26/6/3

"I am a bit doubtful about it [individualised learning] It seems to work well for some teachers at the school here, but there seems to be so little teaching, so little help, they are sort of left to work at their own level. Sometimes I wonder if this is what is required...they do need more help...more teaching help rather than just reading books and doing experiments."

[secondary teacher]

64/9/2

"In many ways kids are turned off science when they ought not to be...a lot of science programs have made a big fuss about making science taught individually...which is O.K. too...it really means that you get science down to a level that the kid is learning it... but it doesn't cover the problem really that unless the science is personal to the kiddie they still might not learn it."

[primary science adviser]

42/6/2

"What we have done is to develop our chart work so that the children can work individually but I still feel that some equipment and some experiments are better done on a class basis than they are in

chart work working as individuals and in small groups...[for example] where there is a need to sequence carefully the use of equipment, particularly where you are using or making oxygen for instance, burning charcoal and that sort of thing."

[intermediate teacher]

So there seems to be advantages and disadvantages. Many teachers who have tried find it is hard work to set up and get operating well.

The following comments from people who have used the approach,

25/5/2

"I've tried if possible to set up schemes where the kids work at their own pace and there are intervals in the middle of the scheme for kids who are moving quickly to, if you like, expand their knowledge. The problem with that of course is that it takes a long time to organise and - so I have to admit that if I don't manage to get a scheme like that sorted out I revert back to the same sort of situation as I had a year or two ago... that is a circus of experiments and the occasional bit of class teaching. This usually happens towards the end of terms...there is no doubt though that a scheme of work like that as far as the teacher is concerned is a better way of going, because it frees you up to be able to spend your time with a small group, with an individual."

[secondary teacher]

18/3/1

"I sort of favour it...but it is difficult to set up in science I think."

[secondary teacher]

25/18/2

"(Is it difficult to accommodate bright and weak kids?) Oh hell yes. When you are putting things together in the first instance you are doing it divorced from the kids...so what you are doing is guessing that this individual will have some difficulty with this particular idea and as a consequence you design some activity to help him with that idea as a piece of remedial work that only they will do, or a number of other kids with the same problem... but whether or not they strike difficulty you never know until you are in the situation."

[H.O.D. science]

38/3/1

"[The work sheets] have got to be presented well and you've got to have plenty of coloured illustrations to grab the kids."

[intermediate teacher]

And there is always that problem of equipment;

38/3/3

"We've thought beforehand the equipment we're going to need for a unit we're doing [individualised approach] and we've planned the unit around it. We haven't got a lot of equipment in here. We're lacking equipment which has determined to a great extent what we have done."

[intermediate teacher]

The equipment problem means that those that want to try individualised teaching or small group work, sometimes just cannot do it.

42/14/3

"I think that kiddies should be doing all the experiments themselves. I don't even like them doing it on a group basis. I would like to see them right down to pairs or individuals where they can proceed at their own rate. I have mixed the groups up today purposely because we have got a lack of materials. We have only got four kits available. [The groups] are far too big. Already as I walked out of the room I see two of them that had switched off in one group because there are too many in there for those kids to cope with [group size: 7-8 pupils]...they wouldn't even play with seven children in the playground!"

[intermediate teacher]

Then there is always the problem of just finding the time for all that needs to be done,

25/1/3

"The biggest problem that I find is [trying to look] at a kid as an individual, trying to decide what I am expecting to get out of that kid for a certain period of time...whether it be one lesson or whether it be a term or whether it be the whole year, and then organising myself...and this really is the problem...organising myself to give that kid the resources to be able to handle the things that I want him to handle. And to be quite frank with you, although that is my ideal, I don't really manage it very well...because I don't have the time."

[secondary teacher]

And finding the right resource material for individualised work if you haven't got time to develop your own:

17/23/1

"I've had a look at the ASEP units-I think although the idea is good the way they treat the pupil...they treat them as an immature sort of imbecile sometimes...although they [the pupils] may have a limited reading age some of the things that they ask them to do I find is of limited value...some things seem too basic."

[1st year teacher]

25/4/2

"I try if possible to use the book resources that we have if I can...as long as I have vetted the book and I know it is suitable for kids at a certain level...I feel probably that it is easier for them to work at their own pace out of a book than it is for them even if I were giving them the same information...than to be listening to me charging through at my pace...whatever my pace might be...too fast or too slow...[also] if they are working out of resource material that we have it frees me up."

[secondary teacher]

Once it is set up it is still hard work if it is to operate successfully,

- 25/18/2 "It is a problem [to get kids to think about their work] because very often kids don't see the point of what it is that they are actually doing. As a consequence their thinking has got no direction at all. What they are good at is talking...describing what actually happens...they are good at it. They focus on some things that I would never dream of looking at even, and so it is a matter of using an individual to promote talk and thinking about that particular activity...actually getting in there yourself and promoting the thinking...giving it some direction."
- [H.O.D. Science]
- 38/3/2 "The problem is with the kids who are very poor readers...you've got to spend a lot of time with them and you have basically got to take them to the chart and read it all for them...you're basically taking a lesson on the blackboard with them."
- [intermediate teacher]
- 18/1/3 "The top band there really enjoyed it [ASEP materials]. They streamed along at their own pace but with the lower band there were certain reading difficulties and a fair amount of guidance was required as far as the text itself was concerned."
- [secondary teacher]
- What do pupils think about it all?
- 12/9/2 Many pupils and ex-pupils we have spoken to have mentioned the
16/2/3 problem of the idle passenger in groups containing large numbers of
15/11/3 pupils, and the preference either for working in small groups or individually,
12/11/2
- 11/3/3 "Another thing that is wrong with science is that they do it in too bigger groups...and if you don't want to do anything then you just pass it on to the next person and they just do it all for you...it would be better in twos then you can do it half each."
- [ex-pupil]
- 7/2/3 "I'd rather do work by myself...I think you probably get more when you are doing research by yourself."
- [ex-pupil]
- 65/4/1 "[I liked working in groups because] if you didn't understand what to do you could ask your friend."
- [intermediate pupil]
- Teachers see more than one side to the views of pupils about individualised work,
- 25/6/2 "Some of the kids didn't like this [individualised approach]. In fact whenever I stood up and taught the class...you know blackboard notes and that sort of thing, I never once had any comments from kids, either pro...or con about the method by which they are learning. When I have used this method though I have had comments...both favourable and unfavourable. And I suppose the reason is, of course, that the kids are used to the first method and so they don't think about commenting about it. But they are

not used to the second method and so they do start commenting about it."

secondary teacher

26/7/2

"Some like the teacher oriented class where they are told what to do...get work set and they are told they have to do that and they do it...when it is left to them [these pupils] don't seem to be quite as motivated as others who work pretty well...but they certainly enjoy it more if it is left to them so it is an individual thing I suppose...the ones that can organise themselves they do adapt themselves nicely to the situation and the ones that don't...they just don't [adapt] whatever you do about it."

secondary teacher

In this discussion we have given a number of views about individualised work. If we had to justify this we would suggest that all teachers, whatever the way they teach or manage their classrooms, really do want all the individuals in their class actively working and learning i.e. teachers wish to create an environment conducive to learning for every individual in the class. However constraints such as class size, lack of suitable written materials, lack of equipment, lack of space, lack of time for preparation, lack of time for teaching individuals all militate against the ideal learning environment that teachers want to establish.⁴

How can teachers then improve the learning environment? There is no simple answer to that. It depends on the teacher, the class to be taught, the possible resources available and the room in which they are taught.

Finally teachers need encouragement and support to innovate. How do you really know until you try it? One phenomena well known to most psychologists and educationists is the Hawthorn effect. Perhaps we need to use it to advantage instead of treating it as an unfortunate side effect in educational research!

⁴ 'Minor' practical constraints can have a major influence on whether a method is used or not. For example a problem with individualised project work in secondary schools is that there is often nowhere for pupils to leave their projects from one lesson to the next.

SUMMARY

This paper, like the other focus papers, mainly asks questions and this it is intended to do. We have raised questions about the rooms in which science is taught and the way in which pupils are grouped into classes. A concern of many teachers at present is the problem of teaching mixed ability classes and the associated need for individual learning programs. While almost all teachers believe in individualised learning in theory - at least for many objectives - a one-to-one pupil/staff ratio will never be more than a dream. The question then becomes, in terms of the reality of large classes, non-ideal classrooms, limited written resources and equipment, how much individualised work is desirable or possible?

But in addition to these questions, a focus on the classroom enables one to see that effective teaching and learning requires a good learning environment. Such a learning environment is not dependent solely on the teacher, or the learners, or the classroom, or the method of teaching but is a result of the milieu created by all of these. It is simplistic to suggest that any one factor has an over-riding influence on a child's learning environment.

If this agreement is accepted it raises questions for the Learning in Science Project, where the ultimate concern is the improvement of the learning environment. It means the project outcomes cannot be straight forward and simple answers to such questions as,

"Is it appropriate to teach the concepts of molecules to Form 3 pupils?"

"Is it better to teach by this method or that method?"

In trying to help teachers can we do more than ensure

- (i) that resource materials are based upon a good knowledge of likely pupil backgrounds, sound scientific knowledge and clear educational thinking about aims and how they can logically be achieved, and
- (ii) that teachers are fully aware of the likely understandings and interests which pupils bring with them to science classes, the range of possible ways classes can be taught and managed and the likely appropriateness of these ways in any given situation, and the range of possible resources that are available?

Those of us working on the Learning in Science Project would appreciate your comments.

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